BELLCOMM, INC.
955 L'ENFANT PLAZA NORTH, S.W. WASHINGTON, D. C. 20024

B70 12072

SUBJECT: Supplemental Note on the Feasibility of the Proposed Dielectric Constant Fxperiment at Lunar Landing Sites - Case 320

DATE: December 24, 1970

FROM: I. I. Rosenblum

ABSTRACT

The transmission loss is calculated for conditions simulating the proposed lunar surface dielectric constant experiment. The analysis employs a geometric optics model using a smooth spherical lunar surface with antenna heights of 25 feet and 6 feet. Transmission loss is evaluated for surface dielectric constant of 2.0 and 4.0 and for signal frequencies of 296.8 MHz and 259.7 MHz. Peak and null points in the loss curve, in the distance range 20 to 150 feet from LM, exhibit level differences that are of the order of 1 db. Considering the additional factors of terrain roughness and other sources of signal variation, these small differences suggest that signal strength measurement with a ± 1db field strength meter as proposed may not provide useful experimental results.

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MEMORANDUM FOR FILE

In a companion memorandum[1] the proposed experiment for determining the dielectric constant of the lunar surface at VHF was examined with emphasis on the magnitude of peak and null field strength measurements at 259.7 MHz for expected values of dielectric constant ($\simeq$ 3.0) and surface roughness (surface standard deviations of .075 to 0.17 meters). That analysis indicated that several incompletely defined signal influences in combination with predictably small peak/null signal variations would probably make the interpretation of experimental data difficult, even for smooth surface conditions.

In the attached Figure 1 the transmission loss, calculated from the Bellcomm, Inc. geometric optics model[1], is given for smooth spherical surface conditions for surface material dielectric constant values of 2.0 and 4.0 and for both 259.7 MHz and 296.8 MHz. The plotted distance is surface distance between antenna base locations. (The free space loss values shown were calculated for the direct path distances between antenna centers). The dielectric constant values 2.0 and 4.0 are quite removed from the nominal value near 3.0 anticipated by most investigators (e.g., Tyler[2], who concludes the value to be 3.0 $\pm$ .2). However, analysis with these values tends to highlight the signal strength sensitivity to this parameter.

The curves in Figure 1 show in the distance interval 20-150 feet that the clearly identifiable peak and null points are as follows:

$\varepsilon_r = 2$, f = 259.7 MHz

Null	@	90 feet
Peak	@	115 feet
Field Strength Difference	-	0.45 dB

$\varepsilon_r = 4$, f = 259.7 MHz

Null	@	20 feet
Peak	@	27.5 feet
Field Strength Difference	-	1.5 dB

$\varepsilon_r = 2$, f = 296.8 MHz

Null	@	98 feet
Peak	@	138 feet
Field Strength Difference	-	1.1 dB

$\varepsilon_r = 4$, f = 296.8 MHz

Null	@	27 feet
Peak	@	34 feet
Field Strength Difference	-	1.1 dB

Null	@	105 feet
Peak	@	135 feet
Field Strength Difference	-	0.3 dB

The general form of the data for both $\varepsilon r = 2.0$ and $\varepsilon r = 4.0$ is essentially the same as previously reported for $\varepsilon r = 3.0$. The largest peak/null difference for any case is still only about 1.5 dB (compared to 0.7 dB at $\varepsilon r = 3$) and would be correspondingly smaller for rough surface conditions.

The above data suggests that because of the small difference in signal levels at the peak and null points to be monitored with the ±1dB field strength meter and the likely presence of several other sources of signal variation of comparable magnitude, that the actual locations of the signal peaks and nulls may not be established with sufficient confidence to permit satisfactory interpretation of results. Therefore, experiment refinements and/or changes should be considered.

I. I. Rosenblum

2034-IIR-ms

Attachments

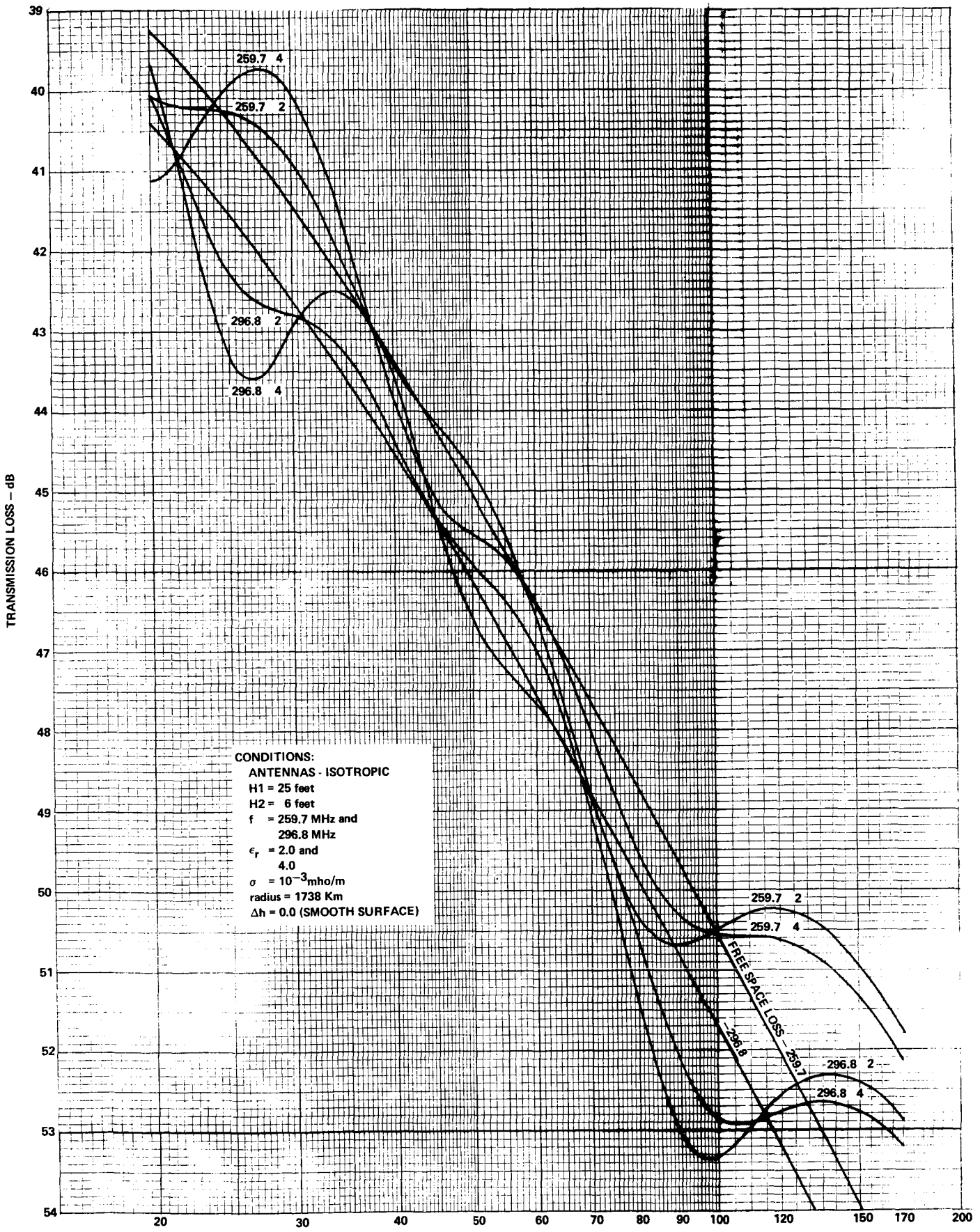

FIGURE 1 - TRANSMISSION LOSS NEAR LM FOR SMOOTH SURFACE AT TWO VHF FREQUENCIES (259.7 MHz AND 296.8 MHz). FOR ϵ_r = 2.0 AND 4.0

REFERENCES

1. Rosenblum, I.I., "Note on the Feasibility of the Dielectric Constant Experiment at Lunar Landing Sites." Case 320, Memorandum for File, September 30, 1970.

2. Tyler, G. L., "Oblique-Scattering Radar Reflectivity of the Lunar Surface: Preliminary Results from Explorer 35" Journal of Geophysical Research, Vol. 73, No. 24, December 15, 1968, pp. 7609-7620.

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